

TAXONOMY, DISTRIBUTION AND RARITY  
STATUS OF *LEAVENWORTHIA*  
AND *LESQUERELLA* (BRASSICACEAE)  
IN KENTUCKY

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ABSTRACT

A taxonomic treatment and illustrations are provided for the three taxa of *Leavenworthia* and two of *Lesquerella* in Kentucky, and the distribution of each taxon in Kentucky is shown on a dot distribution map. The ecology and rarity status of each taxon at the state and federal level are discussed. *Leavenworthia exigua* var. *laciniata* and *Lesquerella globosa* currently are under review by the Fish and Wildlife Service for listing as endangered and threatened, respectively.

The vascular flora of Kentucky is interesting and diverse, but it has never been comprehensively studied. In her bibliography of Kentucky's botanical literature, Fuller (1979) lists many floristic studies but few taxonomic treatments of individual genera or families. With the ever accelerating destruction of Kentucky's natural vegetation, such treatments become vital, not only as a future document of what is lost but to help save what remains. There is currently a great need for reliable information on the extent and status of all of the state's flora, and this is especially true for the rare taxa. Since all five taxa of *Leavenworthia* and *Lesquerella* are rare in Kentucky (Branson et al. 1981; Chester 1982), and since at the time this study was begun *Leavenworthia exigua* var. *laciniata*, *L. torulosa* and *Lesquerella globosa* were under review by the Fish and Wildlife Service for listing as endangered or threatened [Federal Register 45(242): 82517, 82518, 15 December 1980], we undertook a study of the taxonomy and distribution of these two genera in Kentucky. *Leavenworthia torulosa* since has been removed from the list [Federal Register 48(229):53666, 28 November 1983].

## METHODS

This treatment is based on a study of 82 herbarium specimens of *Leavenworthia* and *Lesquerella* collected in Kentucky and located at ALU, APSC, DHL, E GH, KY, Ky. Agri. Exp. Sta. Herbarium, MICH, MEM, MO, PH, PUL, US, VDB and in several private collections and on extensive field work in Kentucky over the past several growing seasons (herbarium abbreviations follow Holmgren et al. 1981). Determinations of taxa were made using keys in Rollins (1963) for *Leavenworthia* and those in Rollins and Shaw (1973) for *Lesquerella*. Measurements of various plant parts cited in the paper were made using a standard dissecting microscope and are based solely on material from Kentucky. Each symbol on the distribution maps is based on an herbarium specimen.

## RESULTS AND DISCUSSION

*Leavenworthia*

Herbaceous, rosette-forming winter annuals; flowers borne singly in erect peduncles, later flowers (if present) borne in lateral, loose racemes; siliques parallel to septum, gynophore short, funiculus free; seeds in a single row in silique, orbicular and flattened (Fig. 1).

The systematics (Rollins 1963), evolution (e.g., Lloyd 1965, 1967, 1969; Rollins 1963; Solbrig 1972; Solbrig and Rollins 1977) and ecology (e.g., Baskin and Baskin 1971, 1972, 1976) of *Leavenworthia* have been studied in considerable detail. All taxa are winter annuals that in presettlement times were restricted to cedar (limestone or dolomite) glades (Rollins 1963). However, several of the species, including those that occur in Kentucky, also now occur in disturbed situations such as rocky pastures and plowed fields (Rollins 1981).

KEY TO THE SPECIES OF *LEAVENWORTHIA* IN KENTUCKY

1. Siliques markedly torulose; wing of seed very narrow or absent . . . . . 2. *L. torulosa*
1. Siliques not torulose; wing of the seed well developed. 2
  2. Petals entire, 5–7 mm long; terminal leaflet not markedly larger than the lateral ones; style short and stout, 1.0–2.5 mm long . . . . . 1. *L. uniflora*
  2. Petals emarginate, 6–10 mm long; terminal leaflet much larger than lateral ones; style slender, 2.0–3.0 mm long . . . . . 3. *L. exigua* var. *laciniata*

1. *L. UNIFLORA* (Michx.) Britton, Mem. Torrey Bot. Club 5:171. 1894.

*Leavenworthia uniflora* is the most abundant and widespread species of the genus. In Kentucky, it has been collected in 12 counties (Fig. 2); it grows on limestone or dolomite glades and outcrops in northwest Georgia, northern Alabama, eastern and central Tennessee, southern Ohio,

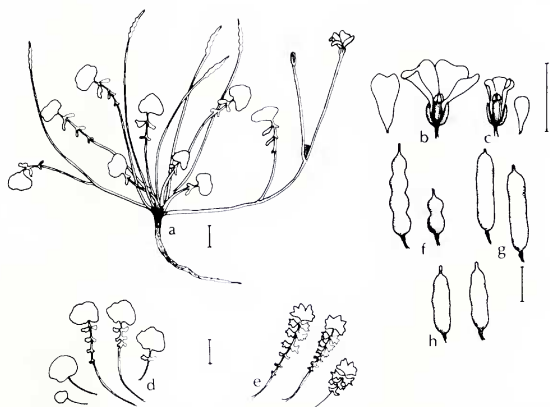


Figure 1. Morphological features of *Leavenworthia*. *L. torulosa*, a. habit, b. flower, e. leaves from basal rosette, f. silique; *L. uniflora*, c. flower, d. leaves, g. silique; *L. exigua* var. *laciniata*, h. silique. Bar equals 1 cm. (Flowers redrawn from Rollins 1963.)

southeastern Indiana and the Ozark Region of southern Missouri and northern Arkansas (Rollins 1963). In Kentucky, *L. uniflora* grows in cedar glades, on disturbed rocky ledges and outcrops and in rocky pastures. Population size varies greatly; often only a few individuals are found at a site, although in favorable situations there may be several thousand plants.

We know of only about a dozen extant populations, but this may be due to lack of thorough botanical collecting in the parts of Kentucky where it grows rather than to its real rarity. In addition, this species is inconspicuous during most of the year, especially during the summer collecting season. Given the large size of several populations and their scattered occurrence over a large area of the state, we do not feel that *L. uniflora* is threatened in Kentucky. It is not considered threatened nationally and is not currently under review. However, *L. uniflora* is listed as endangered in Indiana (Bacone and Hedge 1980) and threatened in Ohio (Roberts and Cooperrider 1982; McCance and Burns 1984).

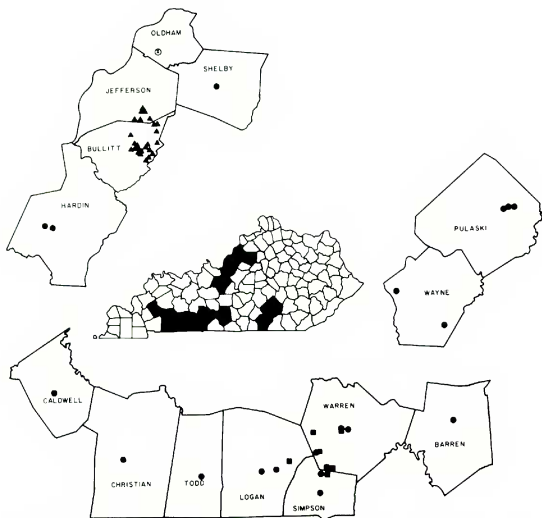


Figure 2. Distribution of *Leavenworthia* in Kentucky. *L. exigua* var. *laciniata* (triangles); *L. torulosa* (squares); *L. uniflora* (circles). Symbols represent exact localities, except for the Oldham County site for *L. uniflora*.

2. *L. TORULOSA* Gray, Bot. Gaz. 5:26. 1880.

*Leavenworthia torulosa* is primarily a species of the Nashville Basin with outlying populations on the Mississippian Plateau of Kentucky (Fig. 2) and in the Ridge and Valley Physiographic Province of east Tennessee (Rollins 1963). It is found on glades and in disturbed rocky pastures, where it often grows in and around seasonal pools and wet depressions. Although not listed from Alabama by Rollins (1963), there is a specimen of *L. torulosa* in the Mohr Herbarium at the University of Alabama in Tuscaloosa (Baskin and Baskin 1984). The label on the specimen indicates that it was collected by Charles Mohr in 1880 in Madison County. The specimen has not been annotated by Rollins, and thus he apparently was

unaware that the species had been collected in Alabama. Mohr (1901) includes the species in his *Plant Life of Alabama* and refers to its rarity in that state.

*Leavenworthia torulosa* potentially may be of economic value. Its seeds contain a high level of the fatty acid eicosenoic acid (Miller et al. 1965) that may prove to be of industrial value. Appelquist (1971) states that further studies of *L. torulosa* should be undertaken if a specific industrial need for eicosenoic acid arises.

Baskin and Baskin (1977) have discussed the status of this species in Kentucky and proposed that it was threatened with extinction in the state. In 1980, this species was under review for listing by the Fish and Wildlife Service as threatened [Federal Register 45(242): 82517, 15 December 1980], but it no longer is under consideration [Federal Register 48(229): 53666, 28 November 1983]. *Leavenworthia torulosa* is listed as endangered in Kentucky (Branson et al. 1981) and threatened in Tennessee (Collins et al. 1978; Tenn. Dept. Conserv. 1982) and Alabama (Freeman et al. 1979). Given the paucity of specimens of this taxon collected in Alabama and the apparent lack of any recent collections, we suggest that it should be listed as endangered in that state. It probably is extirpated in Alabama.

3. *L. EXIGUA* Rollins var. *LACINIATA* Rollins, Contr. Gray Herb. 192: 75, 1963.

*Leavenworthia exigua* var. *laciniata* apparently is endemic to Silurian dolomite and limestone outcrops (cedar glades) of Bullitt and Jefferson counties, Kentucky (Fig. 2). It grows in dry sites on glades similar to those of *L. uniflora*, although it never has been found with this species. *Leavenworthia exigua* var. *laciniata* frequently is found on glades that have been disturbed by pasturing or that occur along roadsides, and it has invaded a plowed field adjacent to a glade at one Bullitt County site.

Baskin and Baskin (1981) have studied the ecology and distribution of this species in Kentucky. *Leavenworthia exigua* var. *laciniata* is currently under review for listing by the Fish and Wildlife Service as endangered [Federal Register 45(242): 82517, 15 December 1980]. Because of its limited geographical range and narrow habitat requirements, we believe that it warrants protection at both the state and federal levels. This taxon is listed as endangered in Kentucky (Branson et al. 1981). *Leavenworthia exigua* Rollins var. *exigua* is listed as threatened in Georgia (McCollum and Ettman 1977) and endangered in Tennessee (Collins et al. 1978), and *L. exigua* Rollins var. *lutea* Rollins is listed as endangered in Tennessee (Collins et al. 1978) and Alabama (Freeman et al. 1979). *Leavenworthia exigua* var. *exigua* and *L. exigua* var. *lutea* currently are under review for

listing as threatened by the Fish and Wildlife Service [Federal Register 48(229): 53652, 28 November 1983].

#### EXCLUDED SPECIES

*Leavenworthia aurea* Torrey was reported from Kentucky by Short (1840). However, material at PH collected by Short and labeled by him as such is *L. torulosa*. One of the specimens is dated 1840, and the other has no date. In 1840, only two species of *Leavenworthia* (*L. uniflora* and *L. aurea*) had been described. Short knew *L. uniflora*, and he must have assumed that any *Leavenworthia* that was not *L. uniflora* was *L. aurea*. *Leavenworthia aurea* is restricted to calcareous glades and outcrops in southeastern Oklahoma and eastern Texas (Rollins 1963).

A specimen of *Leavenworthia stylosa* Gray in the herbarium of the Field Museum (sheet #790163) bears the label "Kentucky," but it is without name of collector or date. Dr. R. L. Stuckey, of The Ohio State University, kindly analyzed the handwriting and confirmed our suspicion that it is not that of Dr. Short. Since the source of the specimen is in doubt and the collector is unknown, this species should not be included in the Kentucky flora until more convincing evidence is found that it does occur in the state.

#### LESQUERELLA

Herbaceous, stellate-pubescent annuals or perennials; flowers orange-yellow (in ours), borne in dense, nearly flat-topped racemes (elongating as fruit matures); siliques globose or somewhat compressed, wall turgid or thin and papery, funiculus attached to septum towards the base, septum entire with prominent central nerve above; seeds globose (Fig. 3).

This genus of about 70 species recently was monographed by Rollins and Shaw (1973). It has been the subject of some interesting studies of inter-specific hybridization (Rollins 1957; Rollins and Solbrig 1973). Seeds of a number of species of *Lesquerella* have been investigated as a source of industrial oils (Hinman 1984). Both species of *Lesquerella* that occur in Kentucky have been investigated for their oil content (Barclay et al. 1962; Mikolajczak et al. 1962). Very little information is available in the literature on the species' ecology.

#### KEY TO THE SPECIES OF LESQUERELLA IN KENTUCKY

1. Plants of alluvial situations; most leaves auriculate; siliques 4–7 mm long, strongly compressed . . . . . 1. *L. lecarrii*
1. Plants of dry, rocky or gravelly situations; leaves never auriculate; siliques 2–2.8 mm long, globose . . . . . 2. *L. globosa*

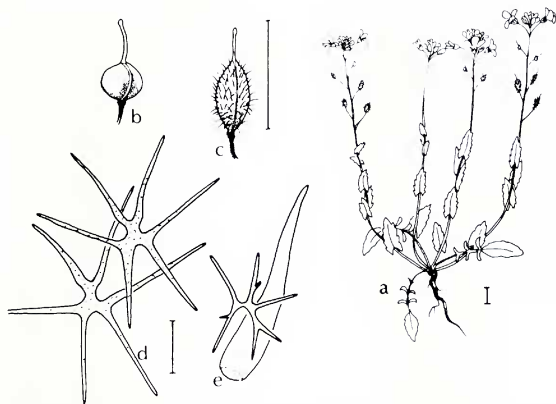


Figure 3. Morphological features of *Lesquerella*. *L. lescurii*, a. habit, c. siliqua, e. trichomes; *L. globosa*, b. siliqua, d. trichomes. Bar equals 1 cm, except for trichomes where it equals 0.1 mm.

1. *L. LESCURII* (Gray) Wats., Proc. Amer. Acad. Arts 23:250. 1888.

*Lesquerella lescurii* recently was collected in Kentucky for the first time, from Trigg County (Fig. 4) just north of the Tennessee state line, by Dr. E. W. Chester of Austin Peay State University in Tennessee (Chester 1982). According to Rollins (1981), it is a species with "weedy tendencies" that grows in old fields, river bottoms and roadsides. In Kentucky, it is restricted to disturbed bottomlands along the Cumberland River. The impoundment of the Cumberland River by Kentucky Dam probably destroyed much of the suitable habitat for this species in Kentucky.

This species was shown to be more abundant in Tennessee than previously thought and thus is no longer under consideration for protection by federal authorities [Federal Register 45(242): 82553, 15 December 1980]. *Lesquerella lescurii* was listed as threatened in Tennessee by Collins et al. (1978), but it no longer is considered to be rare in Tennessee (Tenn. Dept. Conserv. 1982). Apparently, the species has a very narrow geographical distribution in Kentucky and thus is a rare plant in that state.

2. *L. GLOBOSA* (Desv.) Wats., Proc. Amer. Acad. Arts 23:252. 1888.

*Lesquerella globosa* is a taxonomically isolated member of the genus confined to Kentucky (Fig. 4) and Tennessee, except for its occurrence at one outlying site in southwestern Indiana (Rollins and Shaw 1973). It was collected once in Indiana by Deam et al. (1941), but Deam thought that it may have been introduced into that state (Rollins and Shaw 1973). According to Rollins and Shaw (1973), *L. globosa* is a perennial; Payson (1921) says that it is biennial or perennial. Essentially nothing is known about the ecological life cycle of this species, and its autecology is in need of study. We have collected it in a variety of situations, from gravelly roadsides and rights-of-way to (calcareous) shaley, exposed slopes and rocky ledges.

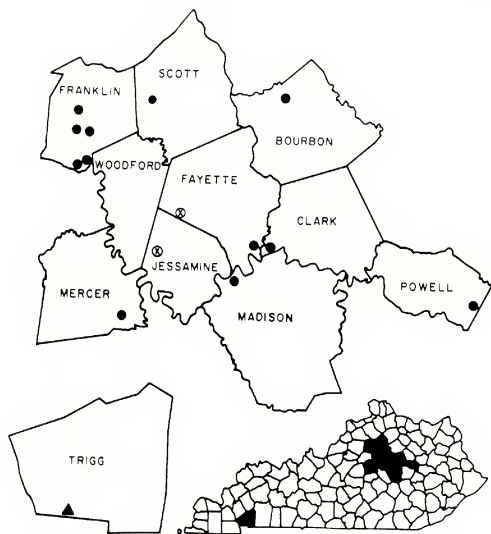


Figure 4. Distribution of *Lesquerella* in Kentucky. *L. globosa* (circles); *L. lescurii* (triangle). Symbols represent exact localities, except for the sites in western Jessamine and southwestern Fayette counties where they are approximate.



Rollins and Shaw (1973) give the distribution of *L. globosa* in Kentucky as Franklin, Mercer and Powell counties, and they cite only one specimen from each county. Interestingly, *L. globosa* has been reported from Ohio (Jones 1940) and Kansas (Rydberg 1932), but apparently there are no specimens from either of these two states.

*Lesquerella globosa* currently is under review by the Fish and Wildlife Service for listing as threatened [Federal Register 45(242):82518, 15 December 1980]. The species is listed as endangered in Indiana (Bacone and Hedge 1980) and as threatened in Tennessee (Collins et al. 1978; Tenn. Dept. Conserv. 1982) and Kentucky (Branson et al. 1981). Although several extant populations in Kentucky are known, the continued existence of this species is precarious. Most of the sites are immediately adjacent to roads, which, if widened, could destroy them. According to Rollins (1952), *L. globosa* is the only species of *Leavenworthia* or *Lesquerella* in Kentucky that does not have weedy tendencies. However, in Kentucky, *L. globosa* has been found along gravelly roadsides and on recent roadcuts.

## REFERENCES

- APPELQUIST, L.-A. 1971. Lipids in Cruciferae: VIII. The fatty acid composition of seeds of some wild or partially domesticated species. *J. Amer. Oil Chem. Soc.* 48:740-744.
- BACONE, J. A. and C. L. HEDGE. 1980. A preliminary list of endangered and threatened vascular plants in Indiana. *Proc. Indiana Acad. Sci.* 89:359-371.
- BARCLAY, A. S., H. S. GENTRY and Q. JONES. 1962. The search for new industrial crops II. *Lesquerella* (Cruciferae) as a source of new oil seeds. *Econ. Bot.* 16:95-100.
- BASKIN, J. M. and C. C. BASKIN. 1971. Germination ecology and adaptation to habitat in *Leavenworthia* spp. (Cruciferae). *Amer. Midl. Naturalist* 85:22-35.
- \_\_\_\_\_ and \_\_\_\_\_. 1972. The ecological life cycle of the cedar glade endemic *Leavenworthia exigua* var. *exigua*. *Canad. J. Bot.* 50:1711-1723.
- \_\_\_\_\_ and \_\_\_\_\_. 1976. Evidence for metabolic adaptation to flooding in *Leavenworthia uniflora*. *J. Chem. Ecol.* 2:411-417.
- \_\_\_\_\_ and \_\_\_\_\_. 1977. *Leavenworthia torulosa* Gray: An endangered plant species in Kentucky. *Castanea* 42:15-17.
- \_\_\_\_\_ and \_\_\_\_\_. 1981. Geographical distribution and notes on the ecology of the rare endemic *Leavenworthia exigua* var. *laciniata*. *Castanea* 46:243-247.
- \_\_\_\_\_ and \_\_\_\_\_. 1984. On the historical occurrence of two cedar glade endemics in Alabama, and a discussion of Mohr's yellow-flowered *Leavenworthia*. *Castanea* 49:167-171.
- BRANSON, B. A., D. E. HARKER, JR., J. M. BASKIN, M. E. MEDLEY, D. L. BATCH, M. L. WARREN, JR., W. H. DAVIS, W. C. HOUTCOOPER, B. MONROE, JR., L. R. PHILLIPPE and P. CUPP. 1981. Endangered, threatened, and rare animals and plants of Kentucky. *Trans. Kentucky Acad. Sci.* 42:77-89.
- CHESTER, E. W. 1982. Some new distributional records for *Lesquerella lescurei* (Gray) Watson (Brassicaceae), including the first report for Kentucky. *Sida* 9:235-237.
- COLLINS, J. L., H. R. DESELM, A. M. EVANS, R. KRAL and B. E. WOFFORD. 1978. The rare vascular plants of Tennessee. *J. Tennessee Acad. Sci.* 53:128-133.
- DEAM, C. C., R. KRIEBEL, T. G. YUNCKER and R. C. FRIESNER. 1941. Indiana

- plant distribution records. Proc. Indiana Acad. Sci. 51:120-129.
- FREEMAN, J. D., A. S. CAUSEY, J. W. SHORT and R. R. HAYNES. 1979. Endangered, threatened and special concern plants of Alabama. J. Alabama Acad. Sci. 50:1-26.
- FULLER, M. J. 1979. Field botany in Kentucky: a reference list. Trans. Kentucky Acad. Sci. 40:43-51.
- HINMAN, C. W. 1984. New crops for arid lands. Science 225:1445-1448.
- HOLMGREN, P. K., W. KEUKEN and E. K. SCHOFIELD (Compilers). 1981. Index Herbariorum. Part 1, edition 7. The herbaria of the world. Bohn, Scheltema & Holkema, Utrecht/Antwerpen. Dr. W. Junk B. V., Publishers. The Hague/Boston. 452 p.
- JONES, C. H. 1940. Additions to the revised catalogue of Ohio vascular plants. VIII. Ohio J. Sci. 40:200-216.
- LLOYD, D. G. 1965. Evolution of self-incompatibility and racial differentiation in *Leavenworthia* (Cruciferae). Contr. Gray Herb. 195:3-134.
- . 1967. The genetics of self incompatibility in *Leavenworthia crassa* Rollins (Cruciferae). Genetica 38:227-242.
- . 1969. Petal color polymorphism in *Leavenworthia* (Cruciferae). Contr. Gray Herb. 198:9-40.
- MCCANCE, R. M., JR. and J. E. BURNS, eds. 1984. Ohio endangered and threatened vascular plants: Abstracts of state-listed taxa. Division of Natural Areas and Preserves, Department of Natural Resources, Columbus, Ohio. 635 p.
- MCCOLLUM, J. L. and D. R. ETTMAN. 1977. Georgia's protected plants. Georgia Dept. of Natural Resources, Atlanta, Georgia. 64 p.
- MIKOLAJCZAK, K. L., E. R. EARLE and I. A. WOLFE. 1962. Search for new industrial oils. VI. Seed oils of the genus *Lesquerella*. J. Amer. Oil Chem. Soc. 39:78-80.
- MILLER, R. W., E. R. EARLE and I. A. WOLFE. 1965. Search for new industrial oils from 102 species of Cruciferae. J. Amer. Oil Chem. Soc. 42:817-821.
- MOHR, C. 1901. Plant life of Alabama. Contr. U.S. Natl. Herb. 6:1-921.
- PAYSON, E. B. 1921. A monograph of the genus *Lesquerella*. Ann. Missouri Bot. Gard. 8:103-236.
- ROBERTS, M. L. and T. S. COOPERRIDER. 1982. Dicotyledons. IN: Cooperrider, T. S., ed. Endangered and threatened plants of Ohio. Pp. 48-81. Ohio Biol. Surv. Biol. Notes No. 16, 92 p.
- ROLLINS, R. C. 1952. Some Cruciferae of the Nashville Basin of Tennessee. Rhodora 54:182-192.
- . 1957. Interspecific hybridization in *Lesquerella* (Cruciferae). Contr. Gray Herb. 181:1-40.
- . 1963. The evolution and systematics of *Leavenworthia* (Cruciferae). Contr. Gray Herb. 192:3-98.
- . 1981. Weeds of the Cruciferae (Brassicaceae) in North America. J. Arnold Arbor. 62:517-540.
- and E. SHAW. 1973. The genus *Lesquerella* (Cruciferae) in North America. Harvard Univ. Press, Cambridge, Massachusetts. 288 p.
- and O. T. SOLBRIG. 1973. Interspecific hybridization in *Lesquerella*. Contr. Gray Herb. 203:3-48.
- RYDBERG, P. A. 1932. Flora of the prairies and plains of North America. Published by the New York Botanical Garden, New York. 969 p.
- SHORT, C. W. 1840. A fourth supplementary catalogue of the plants of Kentucky.

Western J. of Medicine and Surgery 11:283 - 288.

SOLBRIG, O. T. 1972. Breeding system and genetic variation in *Leavenworthia*. Evolution 26:155 - 160.

\_\_\_\_\_ and R. C. ROLLINS. 1977. The evolution of autogamy in species of the mustard genus *Leavenworthia*. Evolution 31:265 - 281.

TENNESSEE DEPARTMENT OF CONSERVATION. 1982. Official rare plant list of Tennessee. 8 p. (unpubl.).